NOAA/FHWA PARTNERING PLAN
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INTRODUCTION & PURPOSE OF DOCUMENT

The purpose of this document is to lay the groundwork for a partnership between the Commerce Department's National Oceanic and Atmospheric Administration (NOAA) and the Transportation Department's Federal Highway Administration (FHWA) in order to achieve their shared goals for a safer and more efficient surface transportation system. Working together improves the likelihood that these agencies will enable transportation users and operators to make more efficient decisions during adverse weather through improved surface weather and road condition products and services. This first iteration of a Partnering Plan begins to establish vision, broad goals, and specific initiatives. The breadth of this plan is five years; however, the focus is on near-term initiatives that have a high probability of success with minimal investment. The *Weather Information for Surface Transportation (WIST) National Needs Assessment Report* (December 2002) serves as a base, with the National Research Council's report *Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services* (March 2004) providing further support and direction. And while this plan addresses only a fraction of the recommendations of these two reports, significant investments beyond current budgets will be needed to fully meet all the needs.

While this document will focus on highway needs as a priority and for prototype purposes, surface transportation, in its entirety, is made up of six major sectors that cover a broad array of personal, commercial and national interests and affect individual and economic safety. These sectors are roadways, long-haul railways, marine transportation systems, rural and urban transit, pipeline systems, and airport ground operations. Weather has large impacts on all these sectors. Additionally, weather impacts in one region have consequences that ripple through interconnected transportation networks, causing bottlenecks, delays in delivery, and imbalances in supply and demand that lead to higher costs for consumers. If capacity-reducing weather variations can be anticipated and communicated, and more precise mitigation measures can be implemented, overall intermodal transportation system efficiency can be improved while operating costs and the number of deaths and injuries can be reduced.

VISION AND GOALS

Vision - To provide the nation with timely, accurate, and relevant surface weather and condition information that supports improvements in safety, mobility, and efficiency during the movement of people and goods.

By working with federal, state, and local agencies; academia; and private industry, NOAA and FHWA will ensure transportation system operators and the public will have readily available surface weather and condition information that meets their needs. While research and

development needs apply to all surface transportation modes, this initial effort will focus on highway needs as a priority and for prototype purposes.

Goals - The following set of major and immediate goals gives targets to work towards, though a sustained and significant level of effort will be required to fully achieve them.

Major Goals:
1. A sustained year-to-year reduction in weather-related surface transportation deaths and injuries through the application of improved surface weather products, services, and training.
2. A sustained year-to-year reduction in weather-related delays and operating costs through the application of improved surface weather products, services, and training.

Immediate Goal (Measurable):
1. The introduction of new products, services, and training outlined in this plan so they are available to all surface transportation operators before and during their surface transportation activities. This is expected to lead to improvements in the application of weather information to surface transportation operations.

FUNDING

Partnering is needed to guide and support the goals of this plan and to secure and maintain advocacy and funding for infusing technology into operations. New relationships among public and private sector groups will require changes in how federal agencies support, coordinate, and participate in the rapidly expanding WIST provider community. The vision of a vastly improved, safe, and efficient transportation system requires WIST users and providers to leverage research plans and funding in a mutually beneficial way. With FHWA and NOAA leadership, these communities must work together to apply the results of weather research and technology development to the spectrum of decision processes needed for surface transportation activities. Wherever possible, both agencies will seek cost sharing arrangements not only between NOAA and FHWA, but also with other surface transportation stakeholders to marshal scarce resources and accelerate improvements in surface transportation products and services.

PLAN PARTICIPANTS

The agencies currently represented by this plan and participating in its development include:
- Department of Transportation
  - Federal Highway Administration
- Department of Commerce/NOAA:
  - National Weather Service (NWS)
    - Office of Science & Technology
    - Office of Climate, Water, and Weather Services
  - Office of Oceanic and Atmospheric Research
  - National Geodetic Survey
  - Office of the Federal Coordinator for Meteorology

Numerous other federal agencies are also investing in prospective solutions or could greatly benefit from them, and will be invited to participate in the plan at the appropriate time, including:
- Department of Transportation
  - Federal Rail Administration
  - Federal Aviation Administration
  - Federal Transit Administration
  - National Highway Traffic Safety Administration
- Department of Defense
- Department of Energy
- Department of Homeland Security
- Department of Interior
- NASA

Outside of the federal government there are a number of partners who will also be given the opportunity to participate, including:
- State Departments of Transportation
- Private sector weather providers
- Vehicle-based industry
  - Vehicle manufacturers
  - Original equipment manufacturers
  - After-market manufacturers
- Communications industry
- Academia

SUCCESS STORIES TO DATE

This Partnering Plan continues a strong working relationship between NOAA and FHWA. There is a long history of collaboration between the two, and many success stories, as captured in the following three examples. The efforts between the National Geodetic Survey, FHWA, and the State Departments of Transportation (DOT) to establish a Differential Global Positioning System network stands out a clear example of what can be achieved when agencies coordinate. Likewise the partnership between FHWA and the NWS to fund five projects under the Cooperative Program for Meteorological Education and Training (COMET) demonstrates a commitment to work together. In the case of those five projects, State DOTs were added to the NWS and university teams to explore ways to make better use of Road Weather Information System (RWIS) data. A third example is the Maintenance Decision Support System project, which leveraged millions of dollars worth of work by the Forecast Systems Lab and others to develop a product for the highway community.

INITIATIVES

The WIST report groups the research and development needs into ten areas. However, the scope of this report is too narrow to define initiatives in all of these areas. Consequently, this first iteration of the Partnership Plan groups the initiatives into five categories: Training, Observations, Numerical Weather Prediction, Databases/Decision Support, and Information Dissemination. The Observation category is further divided into three subcategories: Fixed, Mobile and Remote Sensing. Initiatives are proposed that range from simple to complex and

from short to long durations. The emphasis is on those that can be started fairly easily and use minimal resources. These are grouped into near-term (initiated in 0-6 months) and mid-term (initiated in 6-18 months) initiatives. In addition, these initiatives are then linked to longer-term initiatives that are anticipated to begin in the out years, which will ensure that the near-term initiatives will continue to bear fruit. At this point the focus is on the near-term initiatives, which are described below in detail. Longer-term initiatives are captured in Figure 1 and are briefly mentioned in the text below.

The eight most promising initiatives include:
1. Training for Transportation Operations – Making the Most of NWS Products and Services
2. Training for NWS Field Staff – How the Surface Transportation System Works
3. Integrating RWIS and MADIS
4. Vehicles as Probes – Proof of Concept
5. Numerical Weather Prediction Methods and Practices for Road Weather
6. Prototype Database for Surface Transportation
7. Statistical Guidance
8. Location-specific messaging – Proof of Concept

I. TRAINING

The aspect of Training described below will address the immediate needs of the transportation operators and weather providers, building upon existing materials, resulting in the reduction of weather related crashes, injuries and fatalities.

Initiative #1 - Training for Transportation Operations – Making the Most of NWS Products and Services

Objective – Near term (3-12 months): The preparation of training materials for the purpose of educating transportation decision-makers on existing and newly developed tools that provide easily accessible and understandable information. Training comes out of a documented need expressed by transportation decision-makers, for enhanced training on weather hazards, warning coordination, and communication. Training should be designed to encourage participant interaction for maximum efficiency. The targeted audience should include decision makers for all modes of surface transportation.

Leveraging – The NWS and FEMA have developed training modules to assist the emergency management community attain a better understanding of data and products produced by the NWS. These courses, although developed for emergency management decision-makers, can be modified to satisfy the needs of the transportation decision-makers.

Cost – The cost for such an effort would be minimal, depending on the medium by which the training is presented. Computer based learning (CBL) using available sources such as the COMET VisitView would incur the least expense.

Deliverable – An initial set of published training materials and/or establishment of interactive training sources for transportation decision-makers.

Initiative #2 – Training for NWS Field Staff – How the Surface Transportation System Works

  Objective – Near- and long-term (3 -12 months): Training NWS field staff on the needs and capabilities of transportation decision-makes as users of NWS products and information. Continuing education will be required beyond the development of the initial training efforts.

  Leveraging – Provide NWS forecasters with access to state and federal DOT training opportunities to acquire a better understanding of the needs and difficulties experienced by transportation decision-makers when using surface weather information. This training need can be met through COMET building upon lessons learned (see Initiative #6).

  Cost – This is dependent on the medium chosen to deliver the training. In-residence training will be more costly than CBL.

  Deliverables – Training materials and opportunities that will meet the goal of acquiring a better understanding between the forecaster and the transportation decision-maker.

Future Initiative – Training for Private Weather Providers

  Objective – The preparation of training materials for the purpose of educating private weather providers on existing and newly developed surface weather tools that provide easily accessible and understandable information.

  Leveraging – Where possible, this training can be accommodated through the training experience at the Weather Forecast Office level. This could be accomplished through staff with training experience such as the Warning Coordination Meteorologist, the Science Operations Officer, or other trained WFO staff.

  Cost – Cost will be minimal in most instances and will involve local travel and the cost of training materials.

  Deliverables – Training materials for private weather providers and dispatch operators.

II.   OBSERVATIONS

  The vision of providing the nation with timely, accurate, and relevant surface weather and condition information is dependent upon gathering and providing a large number of reliable observations. The following efforts begin to build these needed databases.

II.A   OBSERVATIONS – FIXED SENSING

Initiative #3 – Integrating RWIS and MADIS

  Objective (near and long-term) – Integrate RWIS-ESS (Road Weather Information System-Environmental Sensor Station) data with the experimental national weather observation server system, MADIS (Meteorological Assimilation Data Ingest System).

  Background - In the last several years, there has been a tremendous expansion in the number of non-NOAA automated weather stations, and groups of weather stations (commonly referred to as "mesonets"), operating across the United States. The expansion reflects the need by many organizations for frequent, densely spaced, real-time surface observations. Sectors requiring this information include: agriculture, energy, transportation, emergency management, fire management, and meteorological research and education. To fill these needs, many state and local government agencies, public utility companies, research organizations, educational institutes, and private industries have installed mesoscale meteorological observing systems.

Additionally, along the nation's highways, there are nearly 2,000 RWIS environmental observing stations installed and operated by state departments of transportation. These stations provide observations of both meteorological variables such as pressure, temperature, winds, and road variables such as pavement temperature and road condition. A recent draft report for the AMS Forum on Weather and Highways states that "it has been clearly demonstrated that RWIS does benefit highway maintenance operations" and recommends that "the infrastructure be designed to ensure that [RWIS] data are collated on a national level and made available centrally."

The framework for such an infrastructure has already been established through the NOAA's MADIS project, which currently ingests meteorological and pavement variables from 12 state DOTs (as part of the over 13,000 mesonet observations from across the country), and distributes quality controlled (QC) information and observations to federal, state, academic, and commercial organizations. MADIS was designed to ingest mesonet observations (in any format), combine the observations from different mesonet data providers, and QC and integrate them with other NOAA datasets by converting the observations to standard observation units, time stamps, and formats.

<u>Leveraging</u> – Capturing RWIS network data available from participating states, and leveraging nearby mesonets will aid in filling data gaps, reducing network costs, and meeting spatial and temporal requirements. Combining data from public, private, local, and national sources can also increase the accuracy of automated QC and data monitoring procedures designed to identify individual erroneous observations as well as longer-term hardware and communication failures. These procedures are generally based on comparing neighboring observations and are therefore greatly aided by an increased density in the observational database.

In addition, the integration of mesonet observations into national weather observation databases promises to improve weather nowcasting and forecast verification; it also has the potential to enable numerical weather prediction models, and other automated meteorological applications, to better capture local and mesoscale weather phenomena. Acquisition of mesonet data can dramatically increase the number and frequency of observations available to weather forecasters and enable them to "fill in the holes" in the NOAA surface dataset and, as such, help them to better identify and predict mesoscale phenomena. Many of the automated mesonet reports, for example, are in remote locations where there are no other observations available to help forecasters monitor developing weather conditions or severe conditions already underway.

<u>Task options</u>
 i. Upgrade/develop RWIS ingest software
 ii. Upgrade RWIS monitoring software
 iii. Upgrade the MADIS to handle increased data volume
 iv. RWIS network ingest (per network)
 v. Current RWIS networks requesting MADIS ingest:

Alaska RWIS	New York RWIS
Nebraska RWIS	Ohio RWIS
North Dakota RWIS	New Jersey RWIS
South Dakota RWIS	Virginia RWIS
Missouri RWIS	Pennsylvania RWIS

(This is a partial list of RWIS networks having contacted MADIS)

vi. Develop and implement a quality control web page
<u>Deliverable</u> – development of a national transportation meso-network.

II.B OBSERVATIONS – MOBILE SENSING

The Mobile Sensing part of the Observations work begins with a short-term feasibility study and would feed into a longer term, more formal demonstration and evaluation. This work would then be combined with work in the other observation areas as part of an optimization study to determine the best balance between the three data sources.

Initiative #4 – Vehicles as Probes – Proof of Concept

<u>Objective</u>: Evaluate the feasibility of using vehicles to gather, validate, and distribute surface weather and road condition data and information.

<u>Background</u>: Useful information about surface weather and road conditions starts with good data, and in order to meet the information needs of all surface transportation users and operators (e.g., commuters, transit operators, trucking companies, train operators), there is a need for dense data collection at the surface. To date, State Departments of Transportation have invested in 2,000+ fixed sensors installed along the roadways, which have proven useful but insufficient due to many data gaps – both spatially and temporally. To fill those gaps, there is a need to explore the use of vehicles as data sources. Data collected from vehicles would serve many purposes, including confirmation of current conditions, as a feed into numerical weather prediction (NWP), as a component of advanced surface transportation weather and road condition information systems, and as a source of archived data.

Such an effort would combine several recent technological advances, such as: precise GPS positioning technologies, calibrated onboard weather instruments, tire sensors, and vehicle-based remote sensing systems – and is collectively referred to as Vehicles as Probes (VAP).

<u>Approach</u>: A near-term initiative will consist of a proof of concept, demonstrating the feasibility of using highway vehicles as probes to collect surface weather and road condition information. Downstream efforts will consist of analyses to explore the optimum mix of fixed, mobile and remote sensors, required sensor density and reporting frequency for given information requirements, ideal data assimilation strategies given the potential volume of data, and opportunities to gather data from multiple surface transportation modes.

For the near-term initiative, a high-level task outline includes:

Task 1 – Determine existing VAP research and investigations. This includes assessing related ongoing activities; identifying pertinent communication standards and systems; initiating dialogues with potential partners (e.g., trucking companies, vehicle system manufacturers and information service providers such as OnStar); and defining required data elements based on existing systems and documented information requirements. The deliverable will be a Concept of Operations, focusing on a first generation system that takes advantage of existing technology.

Task 2 – Deploy VAP system based on the Concept of Operations. In coordination with appropriate partners engaged in this field, develop and deploy VAP systems in a limited area to collect data.

Task 3 – Explore the quality and uses of the data. Once a good data set is collected, it will be studied to determine its quality and the extent to which it supports various information systems. The findings from the analyses will form the basis of an enhanced Concept of Operations and a related recommendation regarding standards, data collection, exchange, assimilation, and archiving.

Resources/Leveraging: A number of ongoing efforts taking place in both the public and private sector minimize the risk and cost associated with the initial effort. This includes ongoing deployments by State DOTs to collect GPS and vehicle data, advancements in vehicle electronics by the automobile industry, and data assimilation advancements.

Audience: There are two primary audiences – those responsible for the VAP deployments, which includes both the public and private sector resources identified above, and those who use the data.

Deliverables: The findings from the initial effort will be the proof of concept and concept of operations for collecting surface weather and road condition data from vehicles. Future work will explore ways to move from a local application to the regional, and ultimately, national level.

II.C   OBSERVATIONS – REMOTE SENSING

There are no near-term initiatives being proposed in this area; however, multiple ongoing activities closely related to this work, such as an expressed interest from NASA to explore the use of their satellites as data sources, warrant identifying this as a potential partnering area.

III.   NUMERICAL WEATHER PREDICTION

Numerical Weather Prediction (NWP) technologies – computers, model software, and statistical post-processing – are evolving rapidly. This category of cooperative work between NOAA and FHWA is intended to ensure that the particular needs of WIST users are met via a continuing program of research and development to continue to improve existing techniques, applications, and products. The value of targeted NWP R&D, coordinated jointly by users, developers, and implementers, is being demonstrated through impressive advancements in aviation weather forecasting services achieved by FAA's Aviation Weather Research Program. This is the interagency relationship envisioned for supporting the WIST user community.

Initiative #5 – Numerical Weather Prediction Methods and Practices for Road Weather

This initiative consists of two parts – a near-term effort tied to the Maintenance Decision Support System (MDSS), and a long-term effort to explore advances in Numerical Weather Prediction (NWP) for other NWS products.

Objectives – Near term: Sustain and advance existing NWP techniques developed for the Maintenance Decision and Support System (MDSS). Longer-range (18-36 months): Continue to improve existing techniques for using multiple forecast models to inform WFO Interactive Forecast Preparation System (IFPS) (and eventually National Digital Forecast Databases (NDFD)) with probabilistic forecasts and other predictions required by the surface transportation community.

Background – In 1999 the FHWA initiated MDSS, a road weather program in cooperation with NCAR, CRREL, FSL, and MIT/LL, which is designed to take numerical weather forecasts and produce automated decision support for snowplow team supervisors. The NWP input for MDSS is a blend of forecasts obtained from NWS/NCEP and those generated by FSL. The FSL service consists of an ensemble of high-resolution regional models, centered on the MDSS domain, initialized every hour (using new radar, satellite, surface, ACARS, and profiler observations), and extending 15 hours into the future. This configuration was arrived at following extensive consultation with laboratory cooperators, state DoT partners, and FHWA. It has changed and improved before each of the three years of live operations, to the point that

today's MDSS system places about 80% of the regression weights on the FSL ensemble models, with the remaining 20% weighting on NCEP's Eta and AVN models. During this iterative process we have learned that 1) the best way to optimize this NWP service is not obvious, 2) the client's requirements are not obvious despite significant efforts by users and providers together to ascertain them, and 3) sustained, incremental improvements to the existing modeling system (and post-processing) are required to exploit NWP for the maximum benefit of this important client class.

　　　Resources – The MDSS was intended by FHWA to be a 5-year development program, and it will expire after the current demonstration taking place in the vicinity of Des Moines is completed. The Colorado Department of Transportation (CDOT) and the E470 Authority have expressed interest in implementing an MDSS test bed in Colorado next winter. This is attractive from the federal perspective because of the challenges of complex terrain and multiple climatic regimes.

　　　Leveraging – Using the resources committed by CDOT and the E470 Authority, it will be possible to sustain virtually all aspects of MDSS for at least one more year, with the exception of FSL's NWP services.

　　　Related activities – 1) Prior to the beginning of the field phase of next winter's MDSS demonstration, NWS will be exposed to the specifics of roadway meteorology for the first time, and it is expected that their experiences and feedback will inform the development of training materials, perhaps through COMET. 2) The ensemble and statistical postprocessing methods already developed for this project are initially aimed at implementation in the Denver WFO's IFPS system; however, they are applicable to the task of accelerating development of NDFD down the path toward excellence for transportation weather problems nationwide. 3) After the MDSS field phase, the weather forecasts made by MDSS will be statistically compared to those made by the Denver WFO forecasters, leading to a report on the current state of NWS readiness to provide services required by the surface transportation community.

　　　Deliverables – By next summer (2005) the participants in the MDSS-related activities expect to produce deliverables attached to the three activities identified in the preceding paragraph, namely: 1) A report on the training needs of NWS forecasters in the area of road weather. We expect to interview participating forecasters before and after the field phase in informal workshops, and use this information to make recommendations in support of Initiative #2 above. 2) A report on the current IFPS products compared to a hypothetical product stream optimized for operations in winter road maintenance, and use this information to make recommendations in support of Initiative #6 below. 3) A report on the current state of NWS readiness to provide WIST. This is envisioned as a superset of lessons learned during next winter's MDSS exercise, intended to assist in the task of planning for future NOAA Initiatives.

IV. DATABASES/DECISION SUPPORT

　　　NOAA data and products form a national and international database and infrastructure, which can be used by other governmental agencies, the private sector, the university community, and the public. Key customers, such as industry, state and local governments, and emergency managers are demanding more reliable and specific weather products for use in making key decisions.

　　　In response to the increased interest and concern for weather information affecting the surface transportation sector, a reliable database containing relevant information to these users can be made available.

Initiative #6 – Prototype Database for Surface Transportation

Objective – Provide an initial fine resolution prototype database that FHWA and its partners can utilize, focusing on near-surface information and forecast elements.

Background – The NWS has a limited number of experimental forecast grids of sensible weather elements (e.g., maximum and minimum temperatures, cloud cover, probability of precipitation) available in what is called the NWS National Digital Forecast Database (NDFD). In addition, national graphics and images from 16 predefined geographic sectors will be made available to the public in 5-km resolution, and will allow those customers and partners to create a wide range of text, graphic, and image products of their own.

The NDFD contains a seamless mosaic of NWS digital forecasts from NWS field offices working in collaboration with NWS National Centers for Environmental Prediction (NCEP). With time, a wider array of forecast elements will be available in the database as will a larger set of graphical presentations.

Leveraging – The NWS already has heavily invested in the development of the NDFD, its initial forecast elements, and other parameters under present development, including visibility and ice coverage. These national mosaics are at 5-km resolution. Users can currently access this experimental data via the Internet and ftp servers. While development of the NDFD continues, it is proposed a parallel, experimental database be created for the purpose of collecting and disseminating observations and weather parameters critical to the needs of the transportation sector.

This database will have a simple IT architecture that mimics the NDFD. The benefit of an independent database in the short- to mid-range timeframe is the speed in which the data can be evaluated and determined to be of use. As relevant observations and existing products are carefully identified (e.g., stationary and mobile observations, statistical guidance, numerical model output) or demonstrated, they can be placed on this server, processed in timely matter, evaluated and used, and recommendations for future product inclusions and improvements can be made. In time, as the products and knowledge of community's needs mature and become known, the data on this database would be ported to the NDFD permanently. The parallel IT architecture will ease the transition time and cost.

Resources – To expand the existing information, efforts would go to investigating and providing the work necessary to include additional derived forecast or guidance elements to an experimental prototype database. Additional server capability and/or architecture issues will need to be resolved.

Deliverables:
1. Products already under development will become available, as they are deemed ready.
2. Additional identified derived elements available to user community, as resources allow.

Initiative #7 – Statistical Guidance

Objective – Provide any already existing short-range statistical guidance on high-resolution grid to user community.

Background - The MOS technique develops prediction equations from both observed and model forecast weather elements, which are then applied to raw model output (the same or similar model) to produce statistical guidance. Because MOS uses NWP output in both the

development and implementation of the statistical equations, time lag can be incorporated into the relationships as well as an accounting of certain systematic model errors such as a dry bias. MOS also calibrates observations at specific locations that are between grid points in the models to NWP forecasts, and can produce probabilistic forecasts for common weather elements as well as forecasts for elements not predicted directly by models.

The MOS interprets NWP models based on historical sampling and is used to predict events forced by synoptic-scale systems, while accounting for both local effects and climate. In making forecasts, the MOS uses three types of input information, namely, NWP model forecasts, prior observations, and geoclimatic data. In the NWS, the MOS approach is part of the complete end-to-end forecast process and is currently applied to both the Eta and Global Forecast System models to provide objective interpretive guidance.

MOS is already used to provide short-range text messages of maximum and minimum temperatures and probabilistic and categorical snowfall amount forecasts for over 1500 hourly observing locations and over 4700 COOP sites around the nation.

Leveraging –Gridded MOS guidance in graphical formats on a high resolution, 5km grid (similar to the grid used by the NDFD) will be produced by the end of the year. The experimental products will first be done over the western U.S. Twenty-four hour snowfall amounts will be among the first elements developed. Other elements include maximum and minimum temperature, probability of precipitation, and probability of thunderstorms. Additional efforts to expand this work could take two possible avenues:

1. The equations for the weather elements used in the "MOS for COOP" methodology could be applied to strategic locations that would benefit the road weather community. In this case, products such as snowfall amount could be generated for RWIS sensor locations or interstate choke points, and made available to the user community and forecasters. This activity has the advantage of taking existing, regionalized equations for elements such as snowfall amount and applying them to new locations.
2. RWIS sites are not currently included in MOS guidance. Another option to expand MOS product generation would be to take selected RWIS locations that meet existing sensor (the environmental sensor station (ESS) at the location) and climatological requirements, and begin work to apply the MOS approach to the data obtained at these locations. This would provide the users with more specific products tuned to the relevant sites, but entails developing the equations to fit to the new sites.

Resources – In the first possible improvement of existing activities, staff time would be needed to fit any regionalized statistical equations (e.g., snowfall amount) to RWIS or other non-COOP sites and examine any existing records, since the equations for certain weather elements already have been developed.

The second activity requires more detailed work. New equations would have to be derived for the new sites based on sensor records and geoclimatic data. The time required for this work is 12-18 months from inception, which places it into the latter portion of the 6-18 month timeframe.

Deliverables – For each activity, products of desired elements fitted to desired locations will be produced and made available. Graphical representation of derived weather elements within the Gridded MOS architecture will be developed.

V.   INFORMATION DISSEMINATION

The key to effective decision-making is getting the right message to the right person in the right format and at the right time – i.e., disseminating timely, accurate, and relevant surface weather and condition information. While there are many challenges within the area of Information Dissemination, the immediate area of interest is within the context of the mobile traveling environment - communicating accurate and relevant information to the correct traveler, in the exact quantity, at the precise time, and at the right location while driving. Once done, this assumes that the vehicle operator will take proper actions based on the information to produce a positive outcome.

Initiative #8 – Location-Specific Messaging – Proof of Concept

<u>Objective</u>: Demonstrate and evaluate the feasibility of providing real-time (pushed), Watches, Warnings, and Alerts on weather events or hazards, or road conditions, via **location-encoded** broadcasts (voice or digital) from the all-hazard NOAA Weather Radio Public Alert system and the Environment Canada emergency broadcast system to mobile vehicle segments. This concept is known as Location Specific Messaging (LSM).

<u>Background</u>: For some time there has been a need to be able to target messages to a subset of the population, delivering timely, localized weather and hazard information to that part of the traveling public to be affected by a given event. This need has been primarily addressed by providing information with more frequent forecast models, 511 call centers, locality-based Road Weather Information Systems (RWIS), etc. The resulting information has been provided over the media airwaves (radio and TV), at rest areas through travel information kiosks, or roadside message boards. These all have demonstrated value. However, these methods can still result in providing irrelevant information, and there is still a need to improve specific spatial and temporal information. Direct, LSM delivery into a vehicle offers the best means of doing so.

<u>Approach</u>: A near-term initiative will consist of a proof of concept, demonstrating the feasibility of delivering real-time surface weather, hazard, or road condition information to one or more mobile vehicles, and data analysis results.

For the near-term initiative, a high-level task outline includes:

Task 1 – Determine and engage current commercial providers.
> This includes assessing related ongoing activities; identifying pertinent communication standards, systems and protocols; defining roles and requirements. The deliverable will be a Concept of Operations, focusing on a first generation system that takes advantage of existing technology.

Task 2 – Expand LSM systems based on the Concept of Operations
> In coordination with appropriate partners engaged in this field, develop and initiate dialogues with other potential partners (e.g., trucking companies, long-haul buses, etc.); further define required data elements based on existing systems and documented information requirements.

Task 3 – Explore the quality and uses of the data, and the results
> Over the time period of the study, collect and study to determine proper outcomes. The findings from the analysis will form the basis of an enhanced Concept of Operations and a related recommendation regarding standard protocols, data collection, exchange, assimilation, and archiving.

<u>Resources/Leveraging</u>: Explore and leverage existing in-vehicle systems and related technology to deliver information to the driving public that will allow for informed decisions on current or pending road conditions, weather event or hazards.

<u>Audience</u>: As far as can be determined, there may be one or two commercial ventures that can be approached for this type of effort (e.g., On Star)

<u>Deliverables</u>: The findings from the initial effort will be the proof of concept and concept of operations for reporting surface weather and road condition data to the vehicles. Future work will explore ways to move from a local application to the regional, and ultimately, national level.

As mentioned in the beginning of this section, there is still some degree of assumption that the vehicle operator will take proper actions based on the information provided. This is an assumption because it is not clearly understood what actions a person will take based on any given message. For example, every day people check the weather forecast to plan their daily activities, but do they really understand what the meteorologist is telling them? The words "watch," "warning," and "winter weather advisory" may be poorly understood by the public, and they may have lost any meaningful relationship to the actual response required of surface transportation operators. Consistency is key, as it is critical for drivers to take actions that won't be unexpected on the part of other drivers. Social Science/Human Factors research is needed to determine how best to structure the disseminated surface weather and condition information to ensure it is comprehended by the general public, thus enabling them to take appropriate action.

CONCLUSION

The WIST Report provides some general conclusions about, and underscores a set of basic information needs for, the surface transportation user community. The four conclusions can be summarized as follows: users recognize the value of weather information; users want weather information tailored to their activities; users' WIST needs cover a broad range of weather elements, thresholds, and lead times; and within transportation sectors and sub-sectors, users differ in their knowledge of how improved weather information could affect their activities and their awareness of WIST. This NOAA-FHWA Partnering Plan begins to address these needs through a broad set of initiatives. While completing these initiatives is only the first step, it is significant in that it demonstrates the benefits gained when two agencies share a vision and the resources to reach it.